Universität Potsdam

UMass Amherst

SFB 1287
Limits of Variability in Language
Cognitive, Grammatical, and Social Aspects
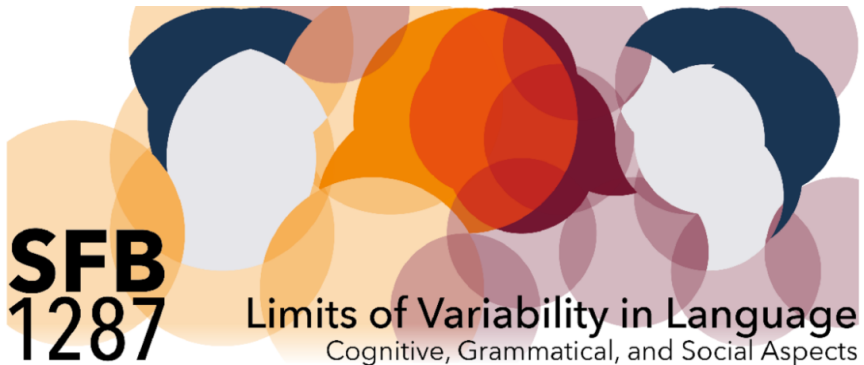
THE TIME-COURSE OF SYNTACTIC AND SEMANTIC INTERFERENCE IN ONLINE SENTENCE COMPREHENSION

Daniela Mertzen[1], Brian W. Dillon[2], Dario Paape[1], Ralf Engbert[1] and Shravan Vasishth[1]
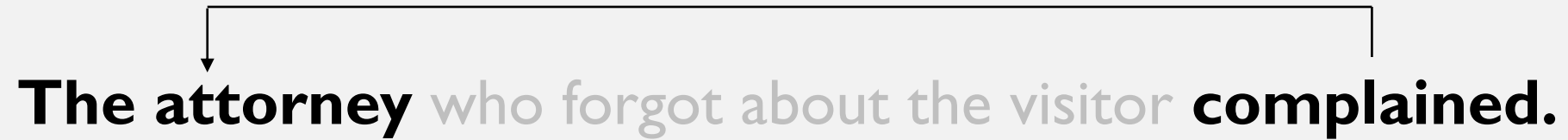
[1]University of Potsdam, [2]University of Massachusetts Amherst

When do **syntactic** and **semantic** information come into play during long-distance dependency formation?

Cue-based theories address this question by studying similarity-based interference effects (McElree, 2000; Lewis & Vasishth, 2005; Van Dyke & Lewis, 2003; Van Dyke, 2007)
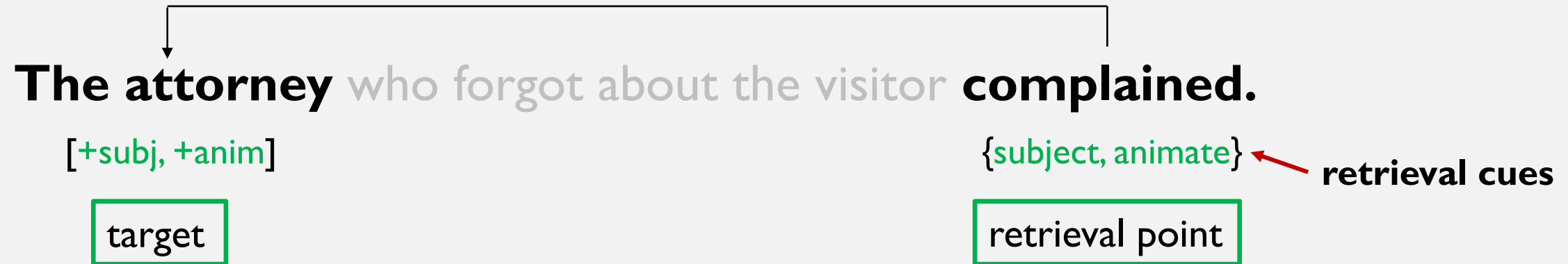
Cue-based retrieval

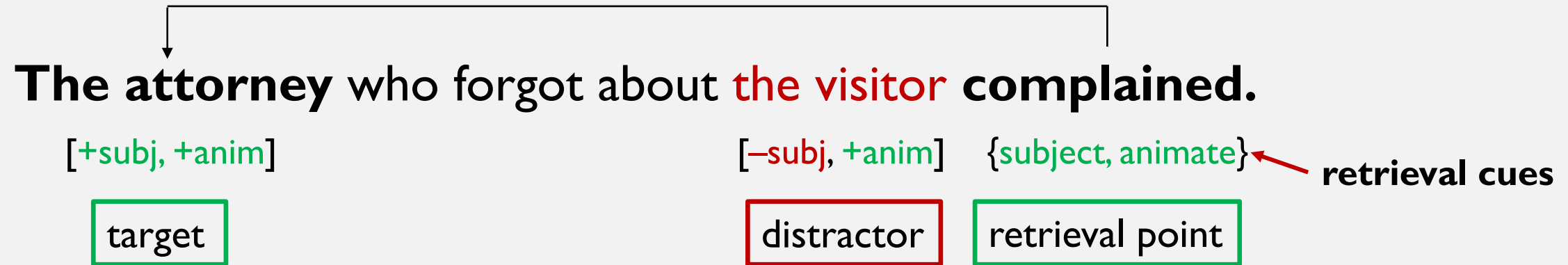**The attorney** who forgot about the visitor **complained.**
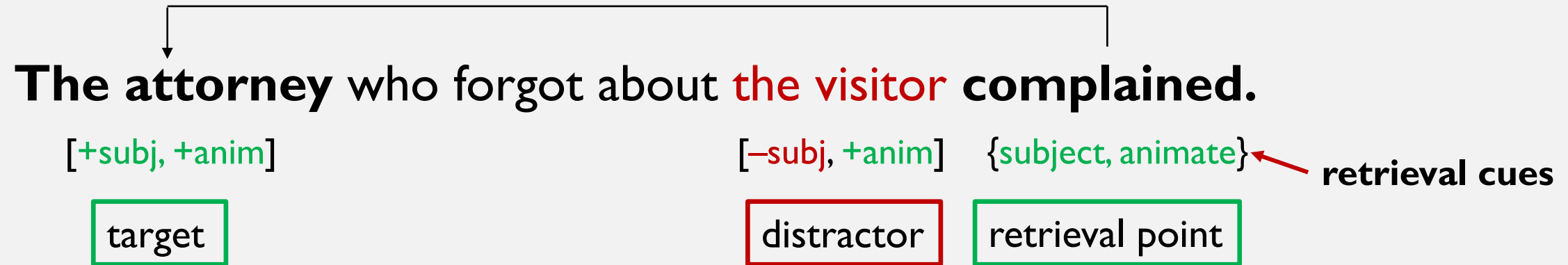
target

retrieval point

Cue-based retrieval

The **attorney** who forgot about the visitor **complained.**

[+subj, +anim]   {subject, animate} ← **retrieval cues**

target   retrieval point

Similarity-based interference

The **attorney** who forgot about the visitor **complained.**

[+subj, +anim]   [–subj, +anim]   {subject, animate} ← **retrieval cues**

target   distractor   retrieval point

Similarity-based interference

The attorney who forgot about the visitor **complained.**

[+subj, +anim]   [–subj, +anim]   {subject, animate} ← **retrieval cues**

target   distractor   retrieval point

- Syntactic and semantic interference occur simultaneously during retrieval

Empirical findings: unclear time-course

Van Dyke, 2007

- Syntactic interference at retrieval point
- Semantic interference sentence-finally

Van Dyke & McElree, 2011

- ET1: Semantic interference at retrieval point
- ET2: No evidence of semantic interference

Experiments

Eye-tracking (reading)
- English (N = 61)
- German (N = 121)

2 x 2 Design

Syntactic interference
- distractor –subject or +subject

Semantic interference
- distractor –animate or +animate

Materials

It turned out that **the attorney** [+subject, +animate] whose secretary

a. had forgotten about the important meeting [–subj, –anim]
b. had forgotten about the important visitor   [–subj, +anim]
c. had forgotten that the   meeting [+subj, –anim] was important
d. had forgotten that the   visitor   [+subj, +anim] was important

frequently **complained** {subject, animate} about the salary at the firm.

Predictions

at critical verb (complained)

… **the attorney** [+subject, +animate]…

a.   … meeting [–subj, –anim]
b.   … visitor   [–subj, +anim]
c.   … meeting [+subj, –anim]
d.   … visitor   [+subj, +anim]   } +subj   slower

… **complained** {subject, animate}

Predictions

at critical verb (complained)

… **the attorney** [+subject, +animate]…

a. … meeting [–subj, –anim]
b. … visitor [–subj, +anim] } –subj

c. … meeting [+subj, –anim]
d. … visitor [+subj, +anim] } +subj | slower |

… **complained** {subject, animate}

Predictions

at critical verb (complained)

… **the attorney** [+subject, +animate]…

a. … meeting [–subj, –anim] ⎫
b. … visitor [–subj, +anim] ⎬ –subj
c. … meeting [+subj, –anim] ⎫
d. … visitor [+subj, +anim] ⎬ +subj [slower]

} Syntactic interference

… **complained** {subject, animate}

Predictions

at critical verb (complained)

… **the attorney** [+subject, +animate]…

a.   … meeting [–subj, –anim]
b.   … visitor   [–subj, +anim]
c.   … meeting [+subj, –anim]
d.   … visitor   [+subj, +anim]

+anim slower

… **complained** {subject, animate}

Predictions

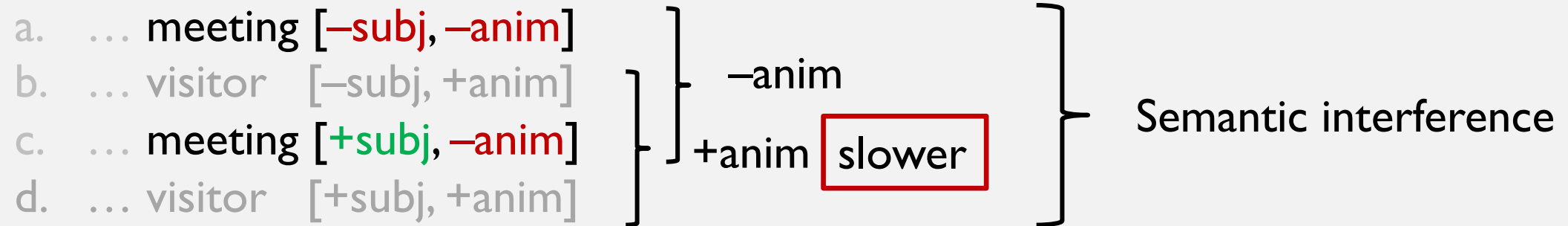at critical verb (complained)

… **the attorney** [+subject, +animate]…

a. … meeting [–subj, –anim]
b. … visitor [–subj, +anim]   } –anim
c. … meeting [+subj, –anim]
d. … visitor [+subj, +anim]   } +anim [slower]

… **complained** {subject, animate}

Predictions
at critical verb (complained)

… **the attorney** [+subject, +animate]…

a. … meeting [–subj, –anim]
b. … visitor [–subj, +anim]
c. … meeting [+subj, –anim]
d. … visitor [+subj, +anim]

–anim

+anim | slower |

Semantic interference

… **complained** {subject, animate}

German materials

Es stellte sich heraus, dass **der Journalist** [+subject, +animate], dessen Kollege
It turned out   that   the journalist, whose colleague…

a. von dem grauenhaften   Skandal   [–subj, –anim] berichtet hatte,
    of   the   gruesome   scandal   reported had,
b. von dem grauenhaften   Mafiaboss [–subj, +anim] berichtet hatte,
    of   the   gruesome   mafiaboss   reported had
c. berichtet hatte, dass der Skandal   [+subj, –anim] grauenhaft war,
    reported had,   that the   scandal   gruesome   was,
d. berichtet hatte, dass der Mafiaboss [+subj, +anim] grauenhaft war,
    reported had,   that the   mafiaboss   gruesome   was,

tatsächlich **log** {subject, animate}, um Informationen zu erhalten.
indeed   lied   to obtain information.

German materials

Es stellte sich heraus, dass **der Journalist** [+subject, +animate], dessen Kollege
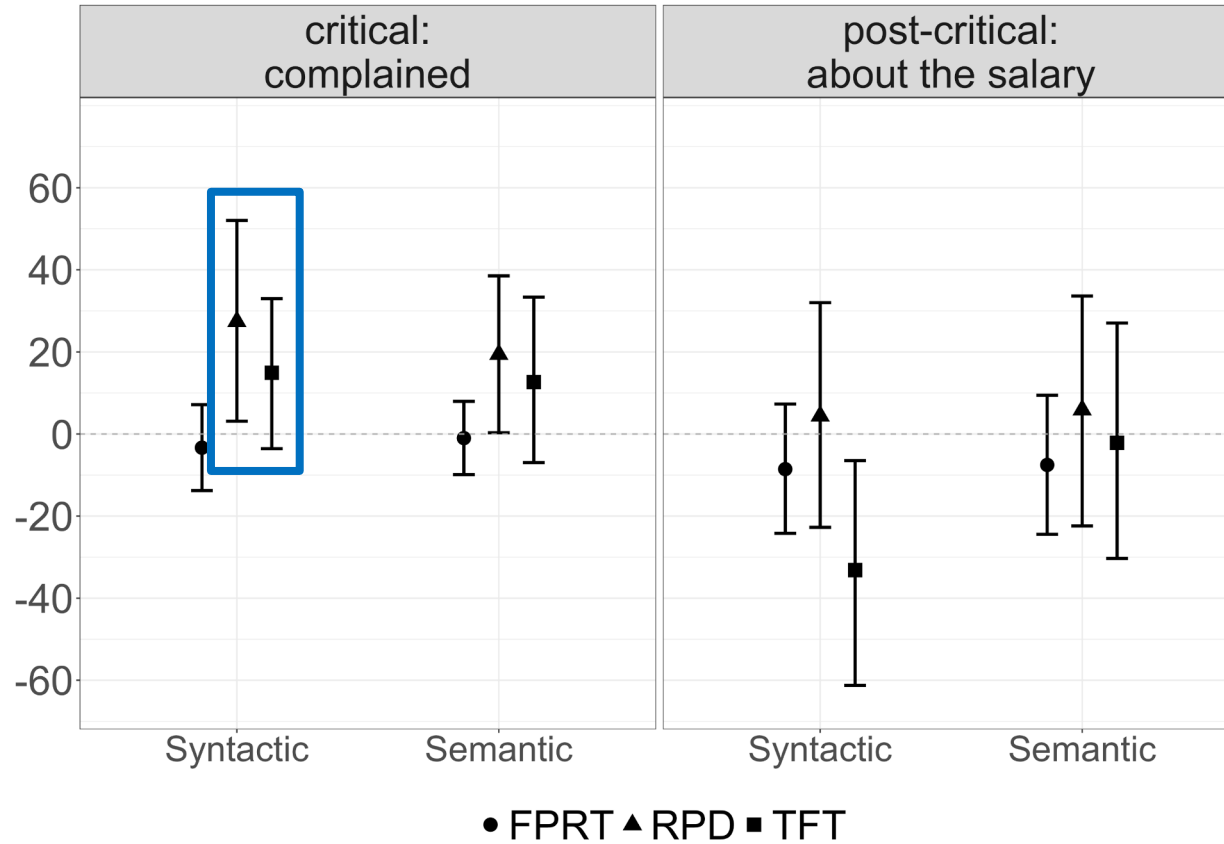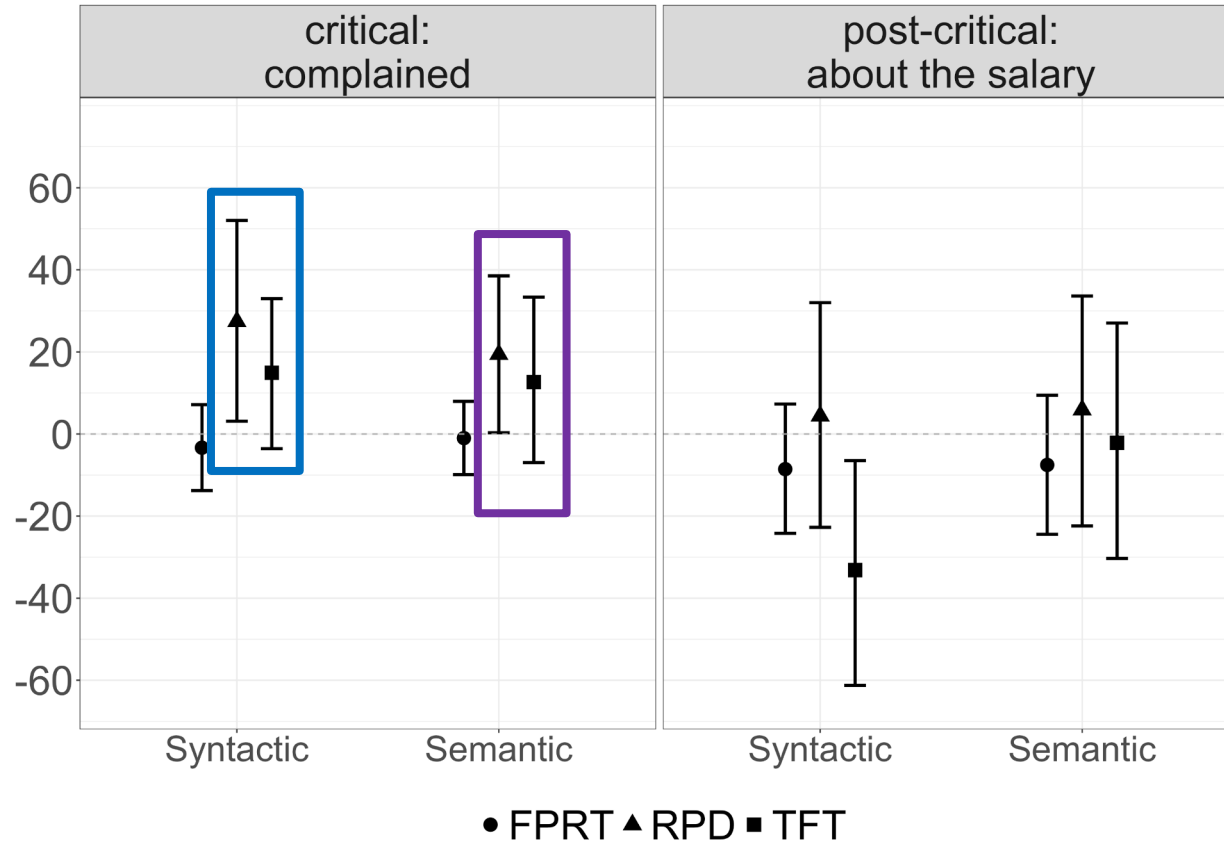*It turned out   that the journalist, whose colleague…*

a. von dem grauenhaften   Skandal   [–subj, –anim] berichtet hatte,
    of the   gruesome   scandal   reported had,
b. von dem grauenhaften   Mafiaboss [–subj, +anim] berichtet hatte,
    of the   gruesome   mafiaboss   reported had
c. berichtet hatte, dass der Skandal   [+subj, –anim] grauenhaft war,
    reported had, that the   scandal   gruesome   was,
d. berichtet hatte, dass der Mafiaboss [+subj, +anim] grauenhaft war,
    reported had, that the   mafiaboss   gruesome   was,

tatsächlich **log** {subject, animate}, um Informationen zu erhalten.
indeed   lied   to obtain information.

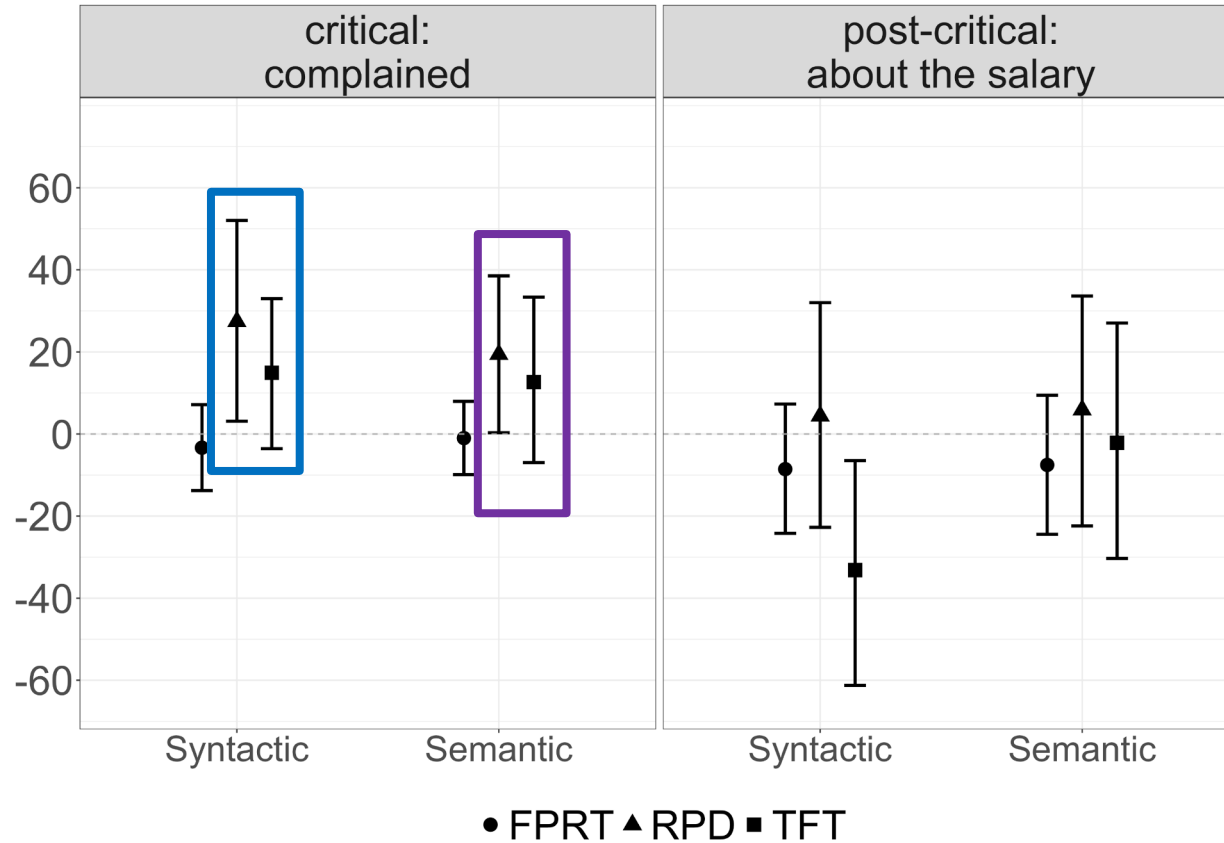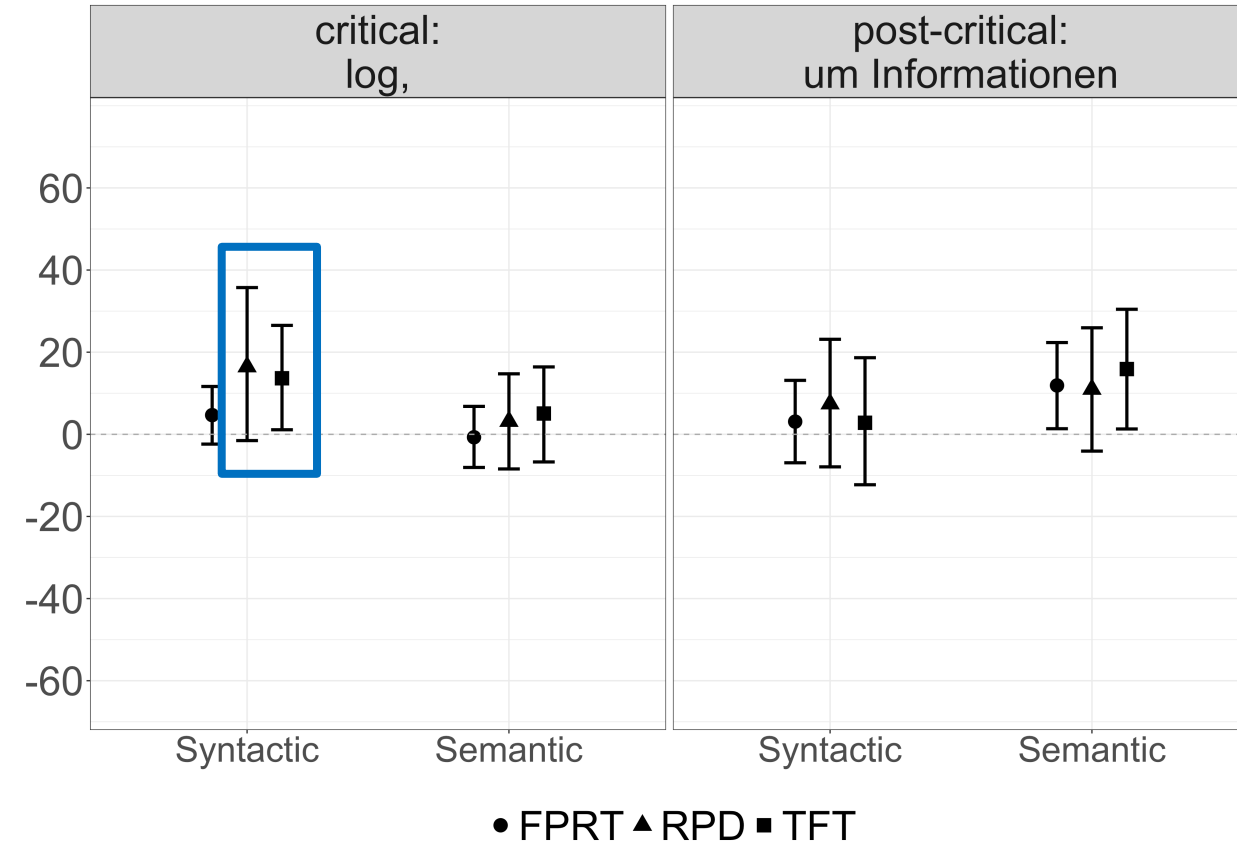*Same predictions*

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Results

English (N=61)

・FPRT ▲RPD ■TFT

Results

English (N=61)

Results

English (N=61)

critical:
complained

post-critical:
about the salary

Syntactic   Semantic   Syntactic   Semantic

● FPRT ▲ RPD ■ TFT

German (N=121)

critical:
log,

post-critical:
um Informationen

Syntactic   Semantic   Syntactic   Semantic

● FPRT ▲ RPD ■ TFT

Results

English (N=61)

| critical: complained | post-critical: about the salary |

German (N=121)

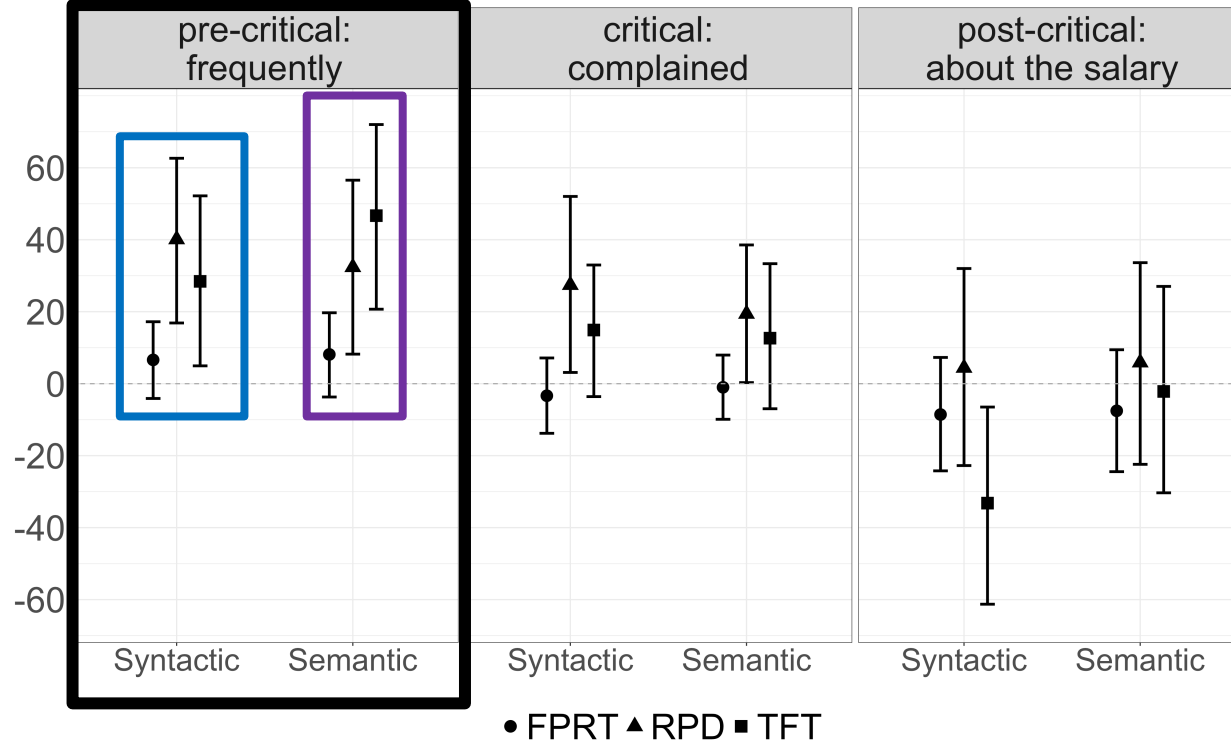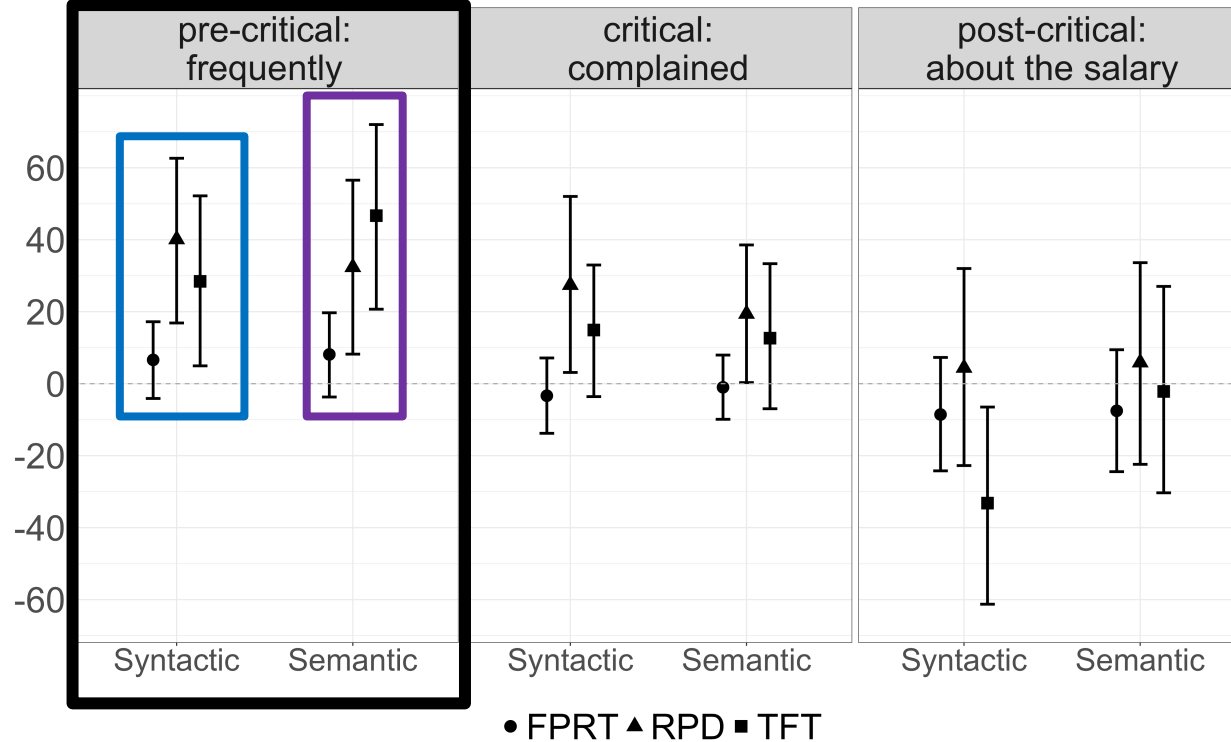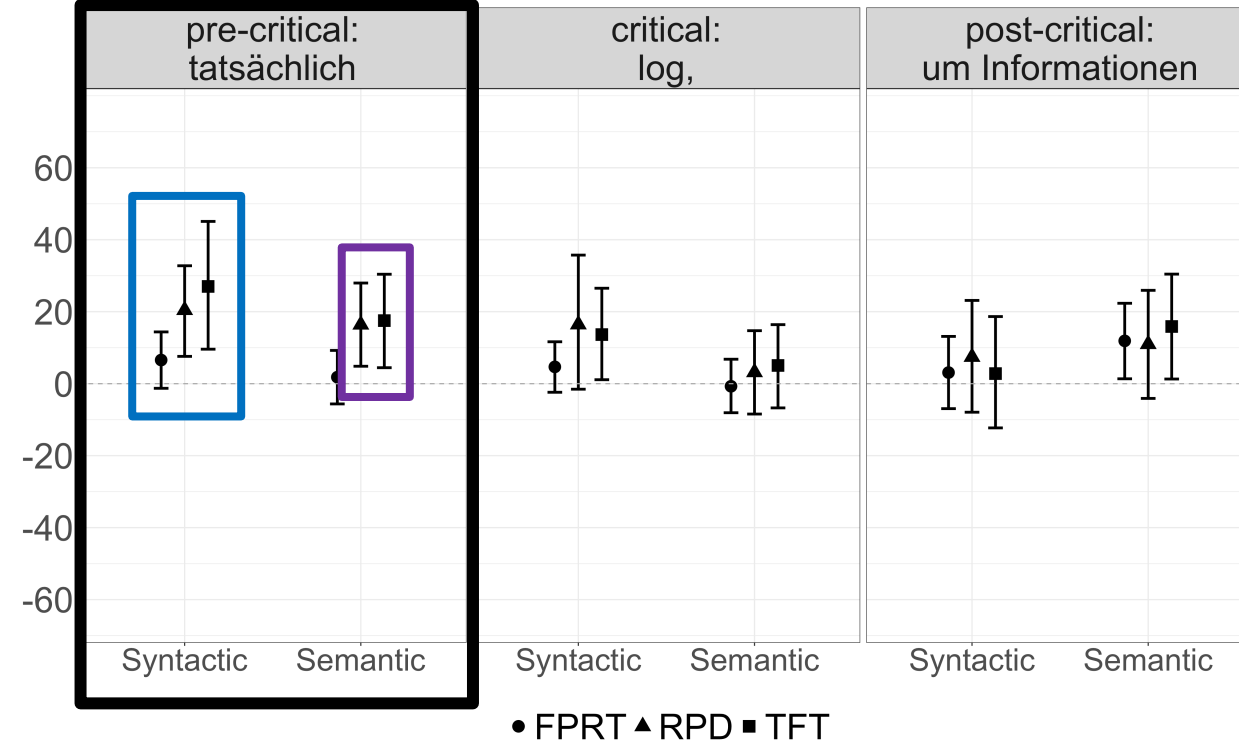| critical: log, | post-critical: um Informationen |

● FPRT ▲ RPD ■ TFT

A twist in the story 😱

English (N=61)

A twist in the story 😱

English (N=61) — German (N=121)

Panels (English): pre-critical: frequently | critical: complained | post-critical: about the salary

Panels (German): pre-critical: tatsächlich | critical: log, | post-critical: um Informationen

Conditions: Syntactic, Semantic

Legend: • FPRT ▲ RPD ■ TFT
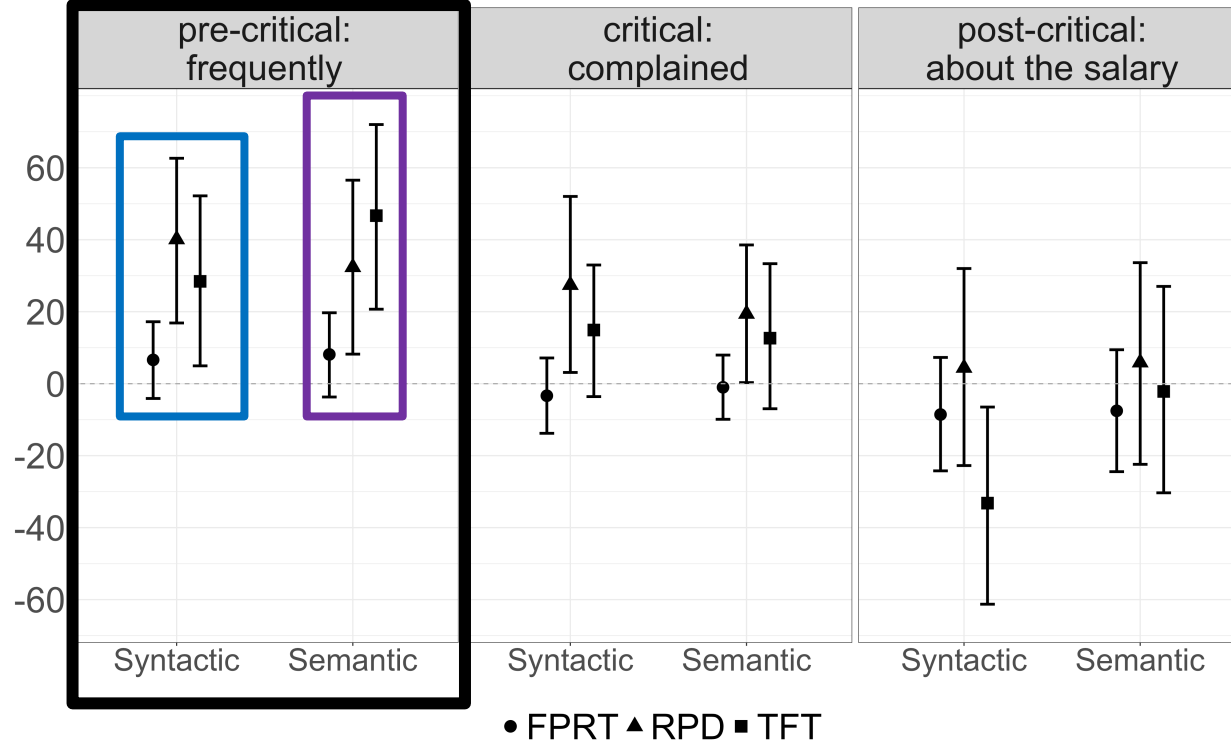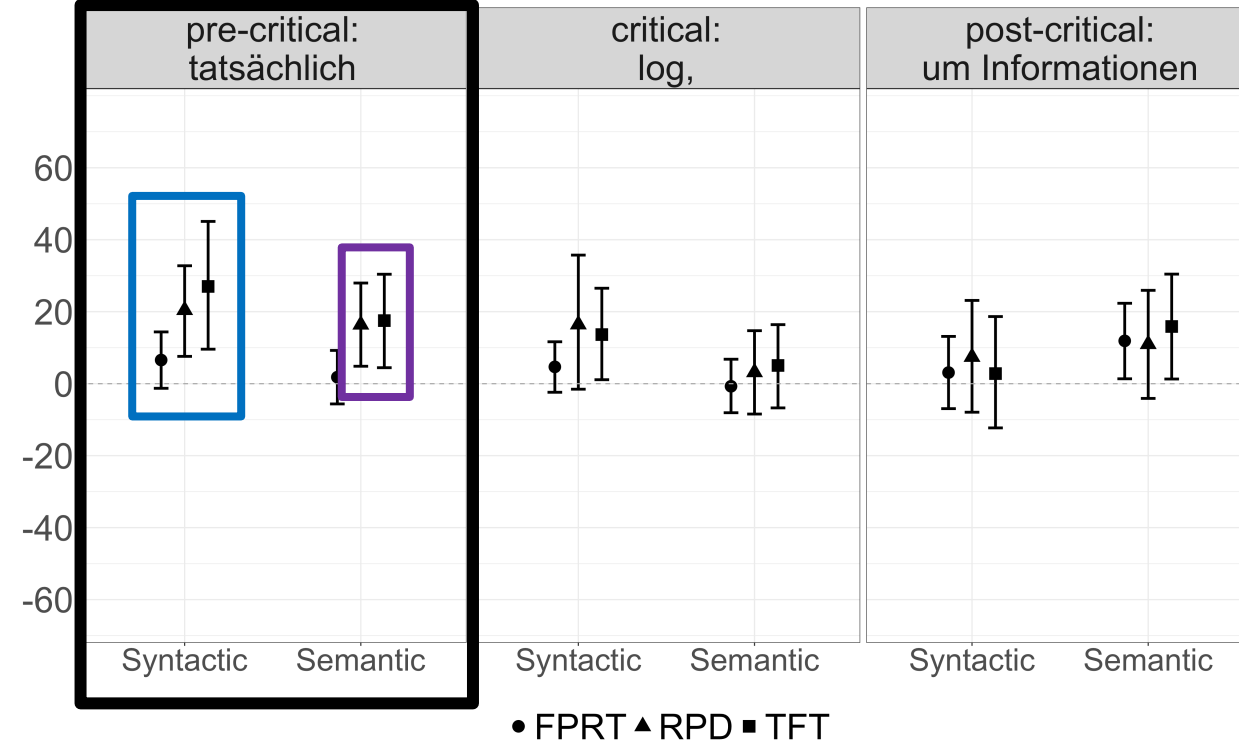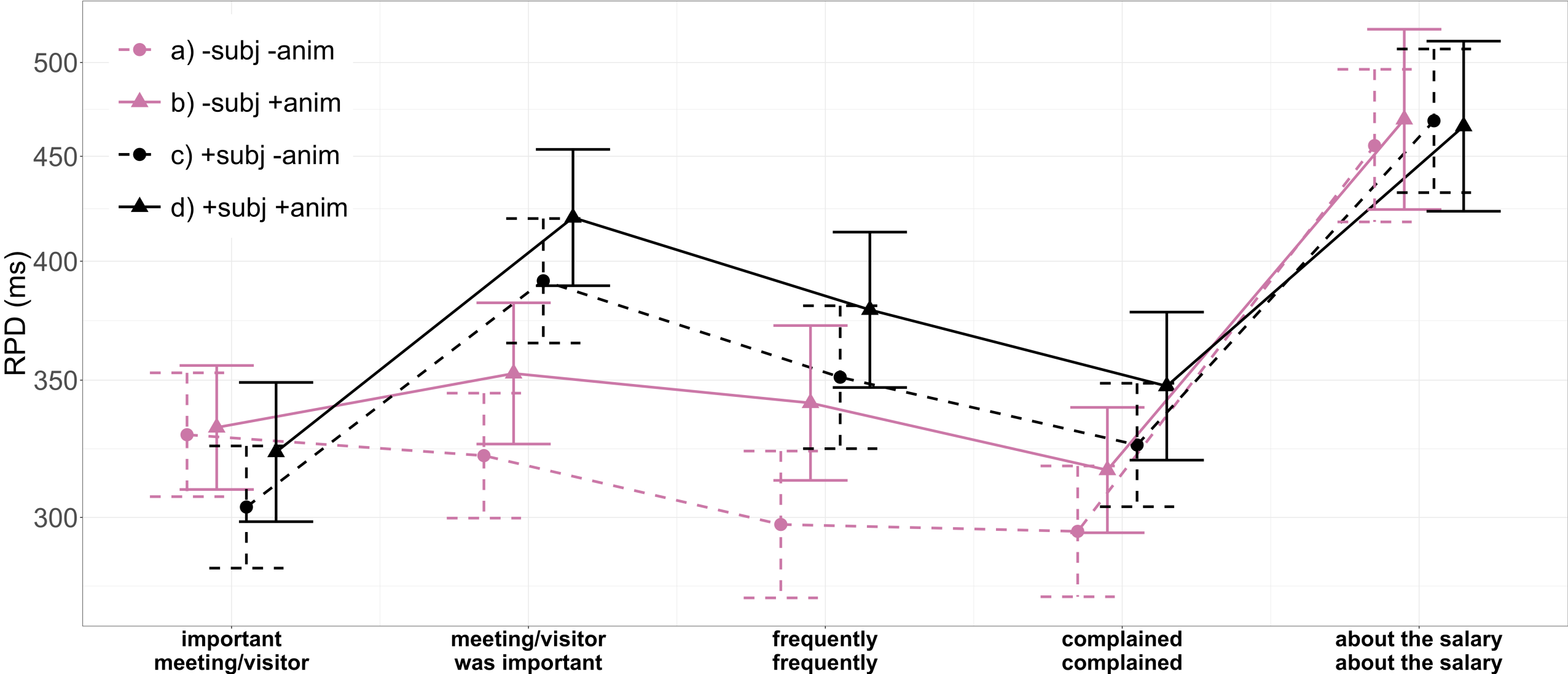
A twist in the story 😱

English (N=61)

German (N=121)

- Interference? (predictive processing?)
- Parafoveal processing?
- Spillover?

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English: RPD by-condition means and 95% CIs

Conclusions

Syntactic and semantic interference can arise simultaneously
- Cue-based retrieval interference?
- Encoding interference?
→ Both types of information can be used in parallel

Conclusions

Syntactic and semantic interference can arise simultaneously
- Cue-based retrieval interference?
- Encoding interference?
→ Both types of information can be used in parallel

Challenge:

Do our designs test what they are supposed to test?
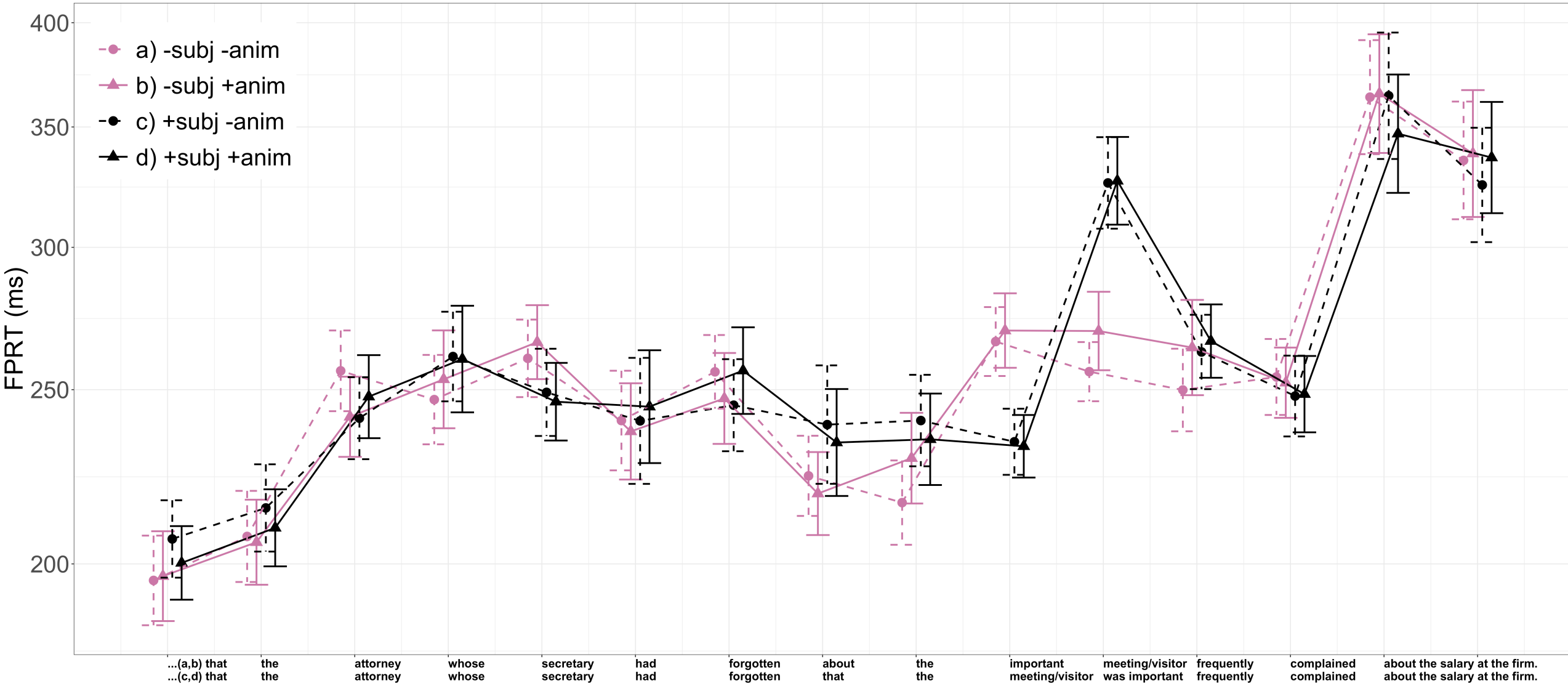How do we deal with pre-critical effects?
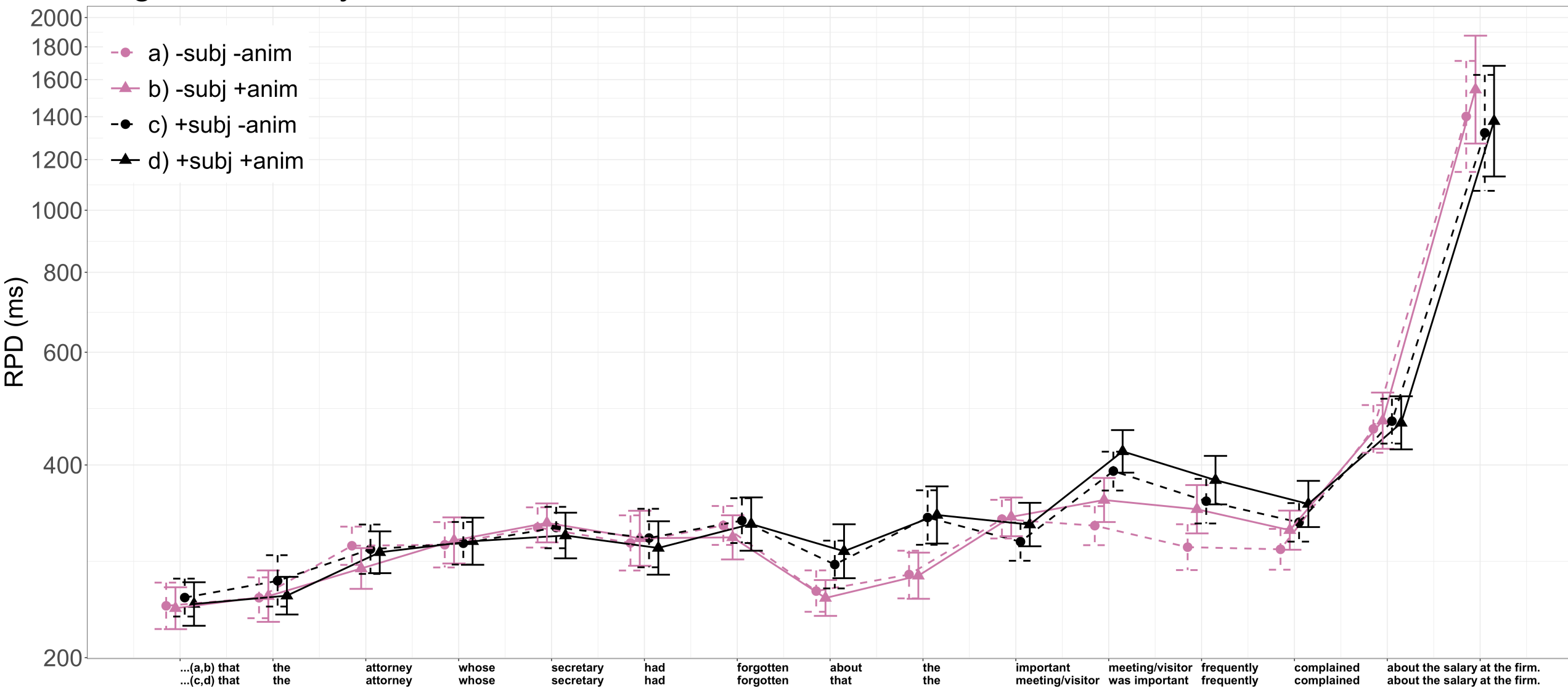
THANK YOU

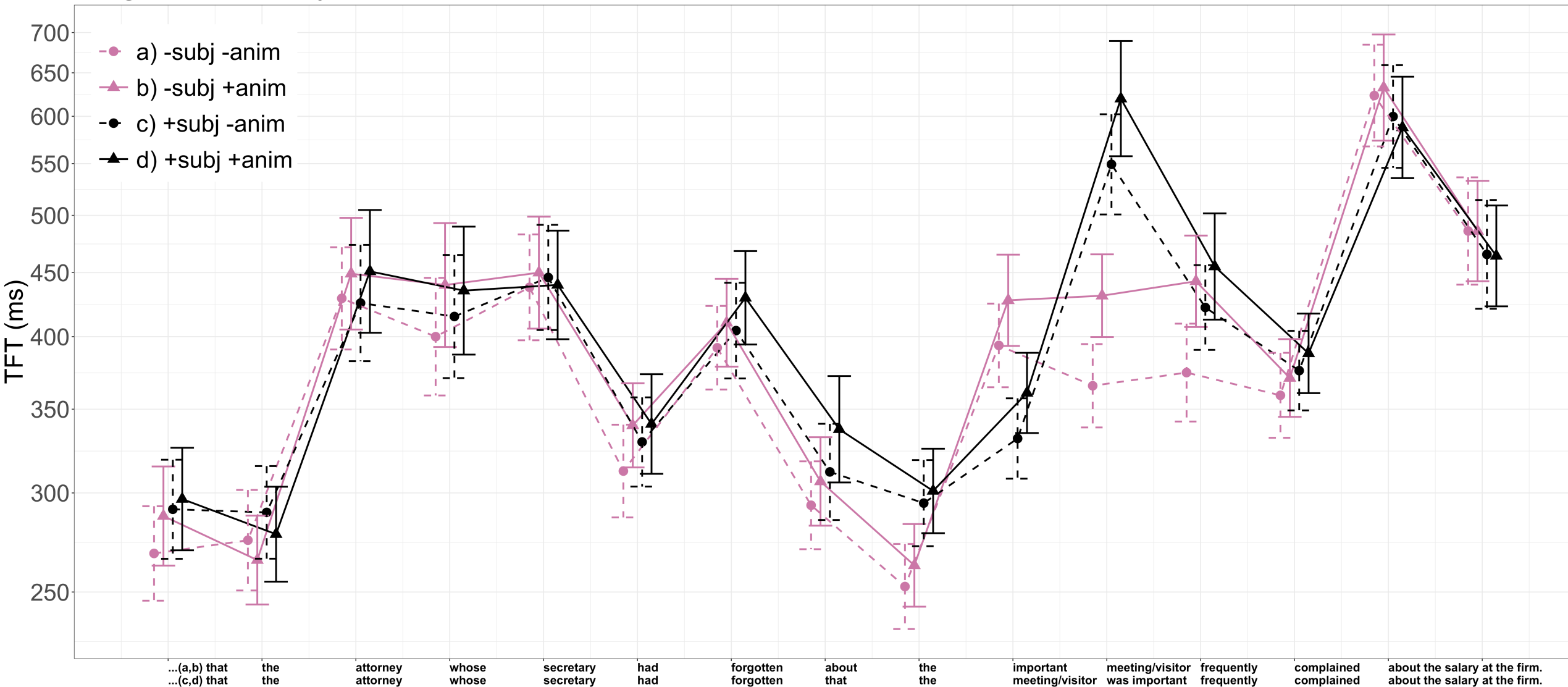Co-authors on this project:
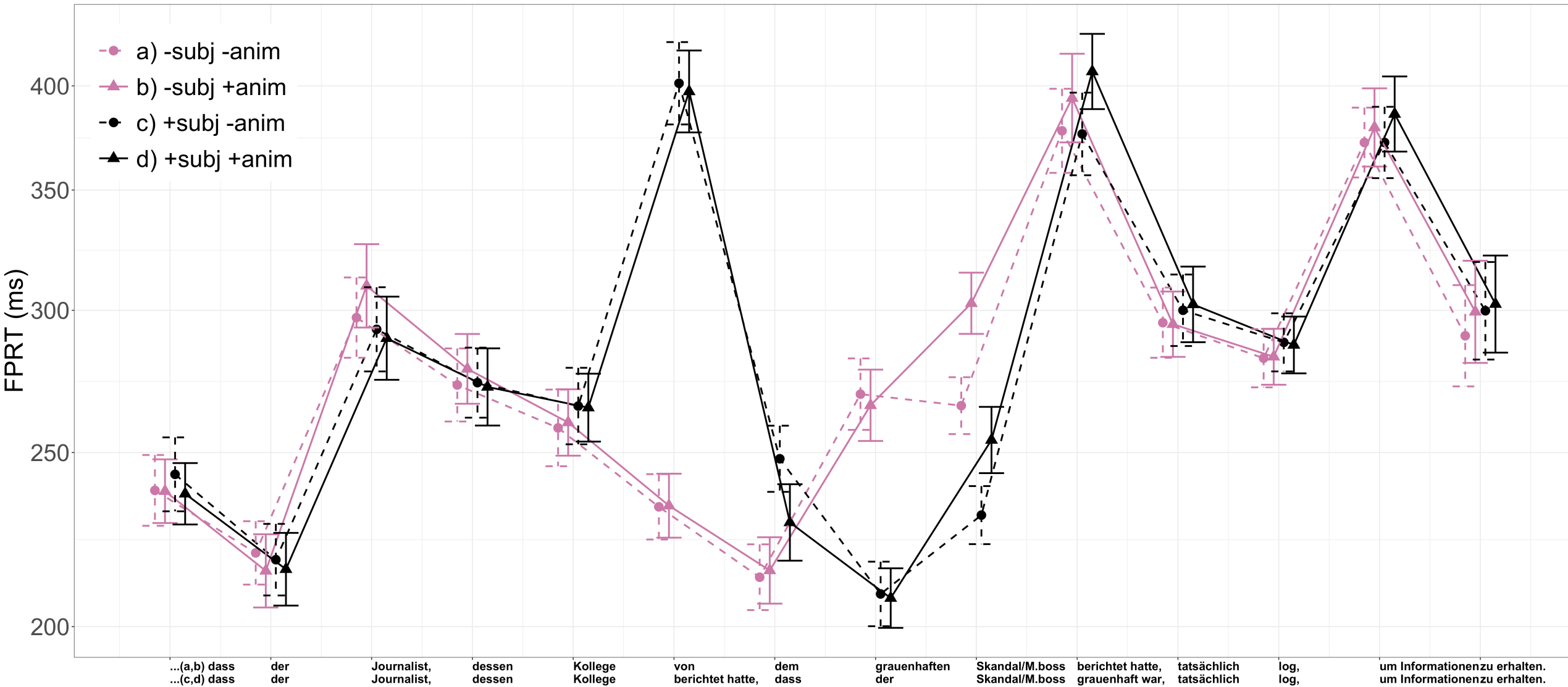
Appendix

English: FPRT by-condition means and 95% CIs

English: RPD by-condition means and 95% CIs

English: TFT by-condition means and 95% CIs

Legend:
- a) -subj -anim
- b) -subj +anim
- c) +subj -anim
- d) +subj +anim

Y-axis: TFT (ms)

X-axis labels:
...(a,b) that / ...(c,d) that
the / the
attorney / attorney
whose / whose
secretary / secretary
had / had
forgotten / forgotten
about / that
the / the
important / meeting/visitor
meeting/visitor / was important
frequently / frequently
complained / complained
about the salary at the firm. / about the salary at the firm.

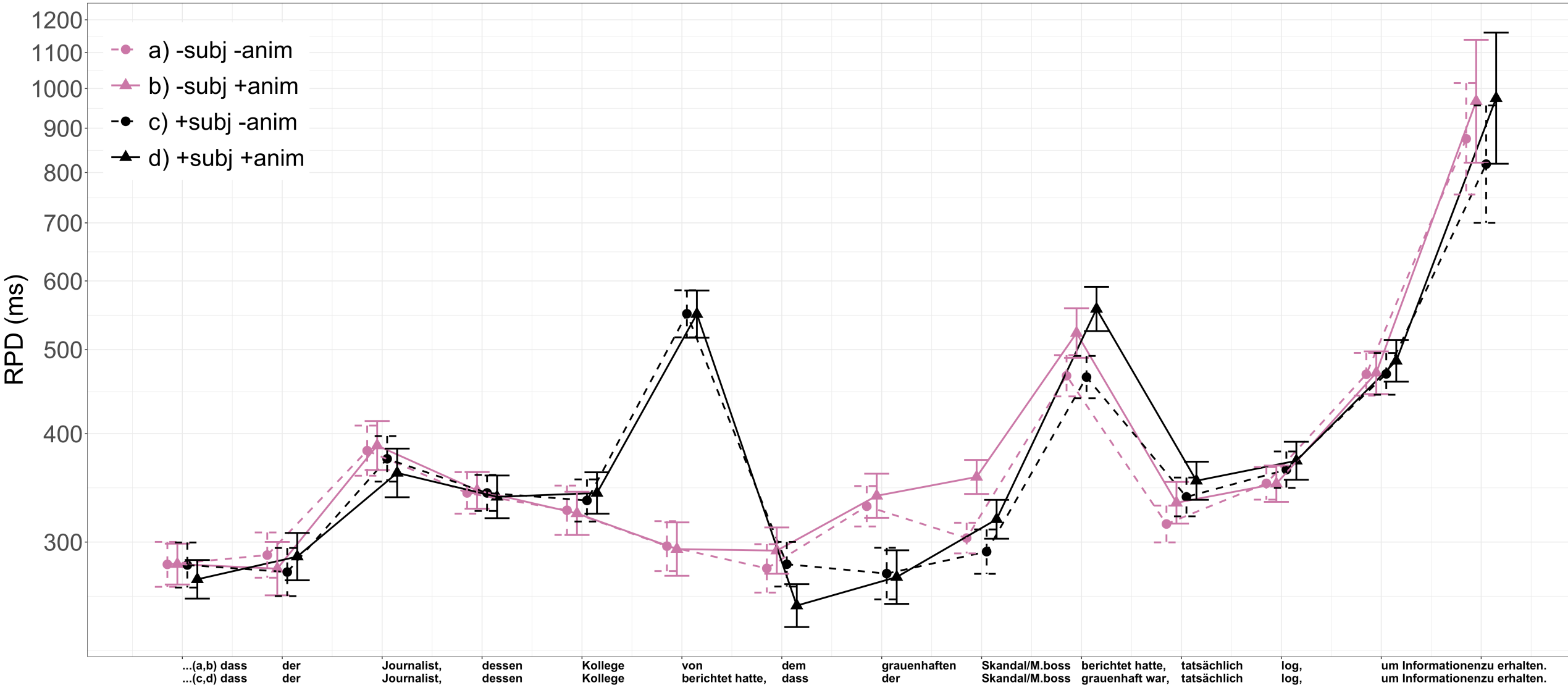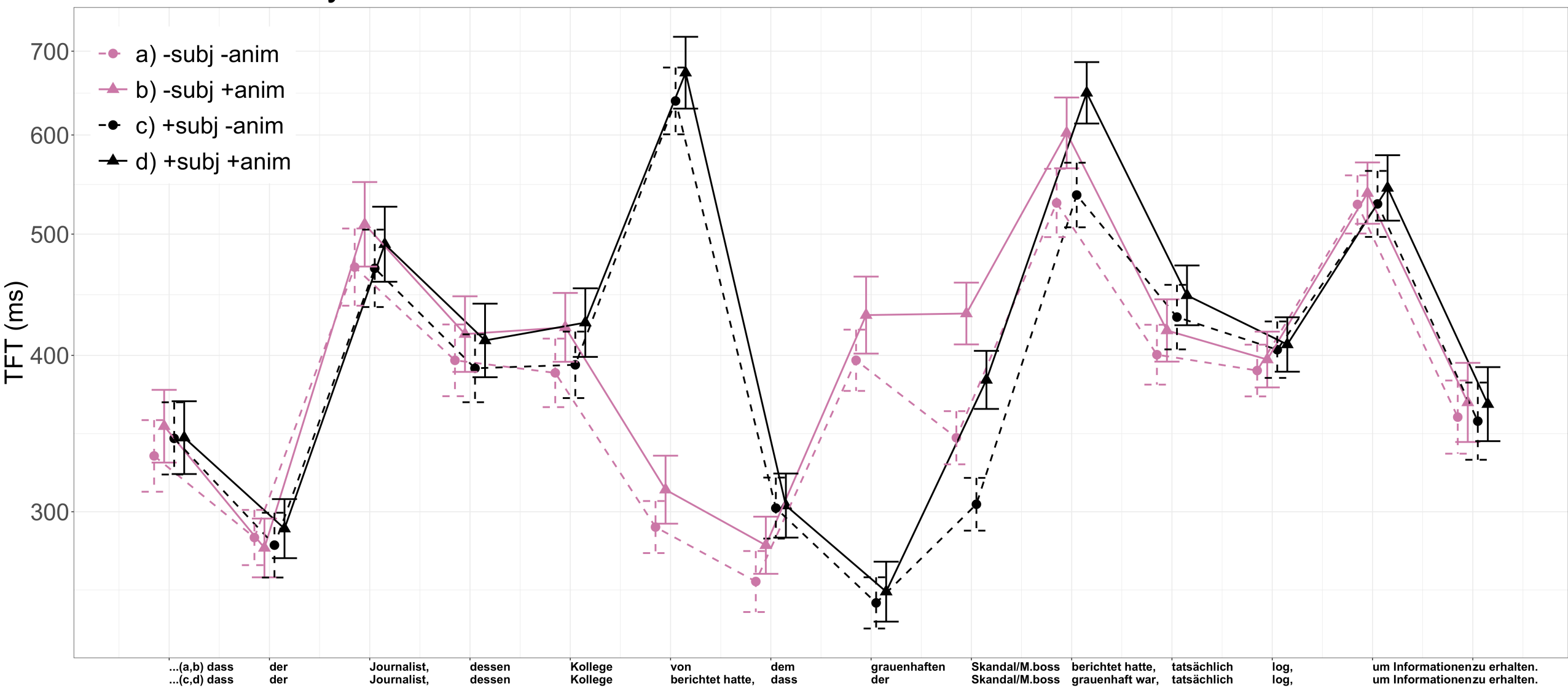German: FPRT by-condition means and 95% CIs

German: RPD by-condition means and 95% CIs

German: TFT by-condition means and 95% CIs

Nested results English

Region	Measure	Fixed effect	Posterior mean [95% CrI]
Pre-critical adverb	Total fixation time	ME Animacy [–Subj conditions]	29 [–1, 61] ms
		ME Animacy [+Subj conditions]	59 [26, 91] ms
	Regression-path duration	ME Animacy [–Subj conditions]	23 [– 8, 53] ms
		ME Animacy [+Subj conditions]	36 [4, 67] ms

Region	Measure	Fixed effect	Posterior mean [95% CrI]
Critical Verb	Total fixation time	ME Animacy [–Subj conditions]	10 [–16, 35] ms
		ME Animacy [+Subj conditions]	15 [–11, 41] ms
	Regression-path duration	ME Animacy [–Subj conditions]	16 [–9, 40] ms
		ME Animacy [+Subj conditions]	18 [–9, 48] ms

Nested results German

Region	Measure	Fixed effect	Posterior mean [95% CrI]
Pre-critical adverb	Total fixation time	ME Animacy [–Subj conditions]	15 [–6, 36] ms
		ME Animacy [+Subj conditions]	18 [0, 37] ms
	Regression-path duration	ME Animacy [–Subj conditions]	18 [3, 34] ms
		ME Animacy [+Subj conditions]	13 [–3, 29] ms

Region	Measure	Fixed effect	Posterior mean [95% CrI]
Post-critical Region	Total fixation time	ME Animacy [–Subj conditions]	19 [–1, 39] ms
		ME Animacy [+Subj conditions]	13 [–7, 33] ms
	Regression-path duration	ME Animacy [–Subj conditions]	18 [–5, 40] ms
		ME Animacy [+Subj conditions]	3 [–18, 25] m

Question response accuracies

	English posterior mean [95% CrI]	German posterior mean [95% CrI]
Syntactic interference	0 [–6, 6] %	4 [1, 8] %
Semantic interference	–10 [–15, –6] %	–11 [–16, –7] %